SECTION 20

REPORTS TO MANAGEMENT

20.1 A formal QA report should be issued to inform appropriate management on the performance and progress of the project workplan. The purpose of the report will be to identify the individuals responsible for reporting QC results, and to present the QC data so that management can monitor the data quality effectively. Assume that all readers of the report will potentially use the document for establishing additional biomonitoring or biosurvey programs for validation of models or for validation of a project. Availability of complete QA/QC program descriptions and data quality requirement calculations is essential (Smith et al. 1988).

20.2 The following items should be described in the QA report:

- Individuals Preparing and Receiving Reports
- Type of Report
  - Written or oral, frequency
  - Interim or final
- Contents
  - Status of the project
  - Results of performance evaluation audits
  - Significant QA/QC problems, recommended solutions, and results of corrective actions
  - Changes in the QAPP
  - Summary of QA/QC program, training, and accomplishments
  - Uncertainty estimates
  - Data quality assessment in terms of precision, accuracy, representativeness, completeness, and comparability
  - Reporting of whether the QA objectives were met, and the resulting impact on decision making.

20.3 The majority of points within the above list are either previously detailed in this document or are largely self-explanatory. The following elaboration for reporting uncertainty and data quality requirements is taken primarily from Smith et al. (1988). See also Section 6 of this document, Green (1979), and Freedman et al. (1991).

Uncertainty estimates may be either qualitative or quantitative. Estimates may focus on the probabilities for false positives or false negatives in hypothesis-testing designs or they may be in the form of confidence intervals around parameter values.

20.4 PRECISION

20.4.1 Precision-reporting can be presented as an index either as standard deviation, relative standard deviation, or as relative percent difference (Smith et al. 1988; USEPA 1989). These numbers can be presented as a function of the measured value within a range, on a graph illustrating actual measurement values, or as data points with a best-fit curve, including confidence intervals.

20.4.2 Numbers should be presented in tabular form with the data quality assessment values, standard deviations, and, if appropriate, regression equation coefficients.

20.4.3 Additional appropriate information should be included that indicates interlaboratory precision versus intralaboratory precision, procedures for arrival at the estimates and assignment of outlier status, and description of the temporal acceptability of the interlaboratory estimates.

20.5 REPRESENTATIVENESS

20.5.1 Representativeness cannot be quantified (Smith et al. 1988). In lieu of quantification, a description of program/project design and implementation activities, along with photographs and drainage area of sampling site distribution (to reflect degree of ecological stratification), and an assessment of resulting representativeness should be presented.

20.6 COMPLETENESS

20.6.1 Missing data should be identified and practical reasons presented that caused their deletion from the dataset. This information will aid in identification of specific procedural problems and in rectification prior to subsequent sampling events.

20.7 COMPARABILITY

20.7.1 Rationale for the validity of comparing one dataset to another should be given. Selected reasons might include:

- time/date of sampling
- comparison of site selection criteria
- measured parameters, recorded observations
- field and laboratory methods
- comparison of QA/QC programs
- comparison of data quality requirement estimates.

20.8 ACCURACY

20.8.1 Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy of data should be checked for transcription errors through the entire sample processing and analyzing phases. Each data entry should be checked to the original field sheet and random quality control checks should be made on subsequent data that have been manipulated.

SECTION 21

DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

21.1 The purpose of this section is to ensure good data by maintaining quality throughout data reduction, transfer, storage, retrieval, and reporting. The project management scheme should outline the path of the data from the field or laboratory; topics to be addressed include details of data storage, data reduction, data validation, and data reporting. All data handling equipment, required hardware and software, and procedures to be used should be identified and described in the plan.

21.2 For each step in the data handling, state the criteria used to review and validate data (accept, reject, or qualify) in an objective and consistent manner. List any calculations that are necessary to prove or disprove the project objectives.

SECTION 22

VALIDATION AND VERIFICATION METHODS

22.1 Outline the process used for validating and verifying data including the chain-of-custody for data throughout the life cycle of the project. Describe how issues shall be resolved and what authorities will handle such issues. Describe how results are conveyed to data users. The review can include checks of field and laboratory QC data, instrument calibration, technical system audits, and statistical data treatments.

22.2 RAW DATA

22.2.1 Data such as species names and number of individuals should be legibly recorded by hand whether on standardized field or laboratory bench sheets, or in notebooks. These sheets should be checked by intralaboratory QC personnel. Raw data (non-manipulated) should be stored in hard copy in one or more separate location(s) and in an electronic database medium with ample backup (if possible). For data validation, compare every computer entry to field sheets to ensure correct data entry.

22.3 DATA REDUCTION

22.3.1 Data reduction is the process of transforming raw data by arithmetic or statistical calculations and collation into a more useful form (such as the Index of Biotic Integrity [IBI] or total taxa). Errors are commonly found in the calculations, reductions, and transfer of data to various forms and reports and into data storage systems. Therefore these data should be quality checked to ensure accuracy.

22.3.2 This subsection should highlight at least the following information:

- names of individuals responsible (Table 4-1)
- examples of data sheets
- summary of statistical approach for reducing data
- summary of data reduction procedures
  control mechanisms for detecting and correcting errors.

22.4 DATA VALIDATION

22.4.1 Data validation is the process of substantiating specified performance criteria. Each program must establish technically-sound and documented data validation criteria which will serve to accept/reject data in a uniform and consistent manner. Pilot studies may be used to determine metrics with the least variability

and to evaluate metrics for their biological relevance; the rationale for their use should be documented.

22.4.2 Information for substantiating data validation should include:

- names of individuals responsible (Table 4-1)
- procedures for determining outliers
- identification of critical control points.

22.5 DATA REPORTING

22.5.1 Data are collected from the summary sheets, bound notebooks, or computerized databases by the data management group and transferred to a draft report table and/or graphical representation. The assembled data and the raw data are then examined for nonsensical, computational, and transcriptional errors. For example, field data sheets should be thoroughly and routinely compared to computer printout data. After reviewing the data, the laboratory leader and laboratory QC officer sign-off on the data report, and the report is forwarded to the Project Manager.

22.5.2 Important information that should be included in this subsection are:

- key individuals who will handle the data reporting (Table 4-1);

- flowchart of the data handling process covering all data collection, transfer, storage, recovery, and processing steps, and including QC data for both field and laboratory; and

- identification of critical control points (i.e., What are the criteria for data points to be considered outliers and when are individual data points rejected from a database?).

SECTION 23

RECONCILIATION WITH DATA QUALITY OBJECTIVES

23.1 The purpose of this section is to describe how the results obtained from the project will be reconciled with the DQOs and how any issues will be resolved. Any limitations on the use of the data must be discussed and reported to decisionmakers. Detailed plans for data assessment procedures for precision, accuracy, and completeness must be identified. Routine assessment procedures including statistics, equations, reporting units, and assessment frequency should be summarized (USEPA 1989). Section 6 details formulae for calculating precision (relative percent difference [RPD] and relative standard deviation [RSD]). Accuracy is usually calculated as "percent recovery". Percent recovery normally applies to chemical analytical laboratory procedures; however, in the case of biological laboratories, percent recovery can be applied in the form of sample sorting checks. Usual procedures for calculating accuracy in this sense then are related to the laboratory. Precision should be calculated based on replicated samples taken from adjacent reaches.

23.2 RPDs or RSDs and completeness should be calculated as soon as possible after each sampling event in order to implement corrective actions (Section 19) prior to subsequent data-gathering efforts. Further statistical approaches which could be calculated and reported (USEPA 1980) are:

- Central tendency and distribution
  - Arithmetic mean
  - Range
  - Standard deviation
  - Pooled standard deviation
  - Geometric mean
  - Data distribution by percentiles
- Measures of variability (USEPA 1989)
  - Accuracy
  - Bias
  - Precision
  - Coefficient of variability (C.V.)
- Confidence limits (Platts et al. 1983)
- Testing for outliers

23.3 Additional statistical guidance can be obtained from Sokal and Rohlf (1969); the statistics associated with the multimetric approach are described by Fore et al. (1994).